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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

STRATTON et al.

Serial No. 09/744,664

Filed: September 18, 2000

Atty. Ref.: 34-105

Group: unknown

Examiner: unknown

For: A ROTARY DEVICE FOR TRANSMISSION OF MATERIAL IN PARTICULATE FORM

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June 14, 2001

Assistant Commissioner for Patents
Washington, DC 20231

SUBMISSION OF PRIORITY DOCUMENTS

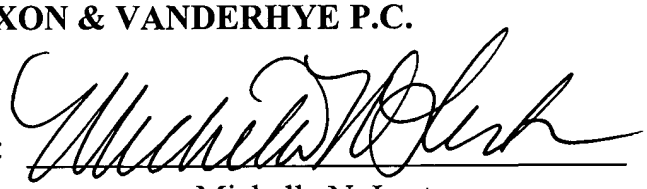
Sir:

It is respectfully requested that this application be given the benefit of the foreign filing date under the provisions of 35 U.S.C. §119 of the following, a certified copy of which is submitted herewith:

Application No.	Country of Origin	Filed
9806709.3	GREAT BRITAIN	27 March 1998

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: 

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I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation and Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein together with the Statement of inventorship and of right to grant of a Patent (Form 7/77), which was subsequently filed.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

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Dated 18 September 2000

Patents Form 1/77

Patents Act 1977
(Rule [redacted])

The Patent Office

27 MAR 1998

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P01/7700 25.00 - 9806709.3

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
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1. Your reference

TGT/JY/27963

2. Patent application number
(The Patent Office will fill in this part)

27 MAR 1998

9806709.3

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

WESTWIND AIR BEARINGS LTD.,
HOLTON ROAD
HOLTON HEATH
POOLE
DORSET
BH16 6LN

Patents ADP number *(if you know it)*

6385300 1

If the applicant is a corporate body, give the country/state of its incorporation

A British Company

4. Title of the invention

"A Rotary Device for Transmission of Material in Particulate form"

5. Name of your agent *(if you have one)*

fJ Cleveland
40-43 Chancery Lane
London
WC2A 1JQ

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Patents ADP number *(if you know it)*

141001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	–
Description	12
Claim(s)	3
Abstract	–
Drawing(s)	1 + 1

10. If you are also filing any of the following, state how many against each item.

Priority documents	–
Translations of priority documents	–
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	–
Request for preliminary examination and search *(Patents Form 9/77)*	✓
Request for substantive examination *(Patents Form 10/77)*	–
Any other documents *(please specify)*	–

11. I/We request the grant of a patent on the basis of this application.

Signature FJ Cleveland Date 27 MARCH 1998

fJ Cleveland

12. Name and daytime telephone number of person to contact in the United Kingdom

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"A Rotary Device for Transmission of Material in Particulate form"

The present invention relates to rotary devices for transmitting material in particulate form particularly for deposition on a surface. The material may be a solid, a liquid, a gel, a powder or a suspension when supplied, but is or becomes particulate when airborne.

Rotary devices are known, for example electrostatically controlled atomising paint spraying devices, where the material to be deposited is forced through a high speed rotary bell-shaped outlet which atomises and directs the material as a conical beam onto a surface while assisted by a high voltage electrostatic charge between the surface and the particles.

Generally the material to be deposited, such as paint, will be a liquid or suspension, but other suspended materials, solids and powders can be handled in this way dependent on the application provided they are able to be in particulate form when airborne.

There are various design problems associated with provision of an efficient rotary deposition device.

It is desirable that an accurate beam of atomised material is achieved with minimum energy input, and for certain applications it is desirable that the unit should be small, light and controllable, particularly when it is to fit on the end of a robot arm.

To this end a conical or cylindrical curtain of high velocity air can be supplied so as to encircle the emerging conical beam or mist of atomised particles. This constrains the beam so as to re-shape the beam into a more closely confined and accurate spray.

However a problem arises in that the velocity required for the shaping air curtain needs to relate to the particle velocity required for adequate atomisation. Otherwise there is a risk of damage of the mist shape and coagulation of the mist particles.

According to one aspect of the invention therefore there is provided a device for transmitting a beam of material in particulate form,

comprising an outer bell-shaped member which is rotatable about a principal axis and arranged to project a conical curtain of small particles flowing generally towards a

target,

supply means for supply of material from a reservoir source and centrally outwards from said principal axis and towards a peripheral internal shaping region of said outer bell-shaped member to create said conical curtain of small particles

characterised in that an inner rotary bell-shaped member is provided co-axially with said outer bell-shaped member and is arranged to rotate at a different rate to that of said outer bell-shaped member so that at least a major part of the material emerging from said supply means is subject to differing rotary forces imparted by both the inner and outer rotary bell-shaped members.

Generally for best results an inner surface of the outer bell-shaped member in an operative region where it receives emergent material for atomisation should be roughened. Also it is desirable that the outer bell-shaped member should in its operative region extend outwardly of the inner bell-shaped member.

Use of two bell-shaped members has the immediate advantage that the velocities required for adequate

atomisation or mist production can be substantially reduced. This means that if an external air curtain is to be used, the differences in velocity of the mist particles and of the air curtain can be reduced, and so better results can be achieved.

Generally the two bell-shaped members will rotate in opposing directions, but that is not always to be preferred. In some cases rotation in the same direction but at significantly different rates will be effective.

Other benefits of reduced velocity are that less energy is required, and that - even in the absence of an external air curtain - the conical beam will be subject to less external scattering since the centrifugal velocity energy of the particles (dependent on the square of the velocity) will be reduced.

Another advantage is that the difference in speeds of the two bell-shaped members can be adjusted if desired in order to optimise performance of the device. If this is required, the two bell-shaped members should be independently adjustable in speed.

Preferably a centrally located diffuser disc is provided

externally to said supply means and perpendicular to said principal axis and includes a centrally located deflector which deflects at least some of the emergent material into contact with an internal surface of said inner bell-shaped member and thence to an internal surface of the outer bell-shaped member. The rotary diffuser disc may be integral with the inner bell-shaped member so as to rotate integrally with it. Preferably the remainder of said material is arranged to be passed through apertures in said disc and onto an external face of said disc and then to be fed centrifugally into the region of said peripheral internal shaping region of said outer bell-shaped member.

Generally it is preferred to provide an external cylindrical or conical curtain of air surrounding said beam of particles. Since air under an elevated pressure is required for this purpose, it is convenient to use the same air pressure source for other functions within the device.

The two rotary bell-shaped members can be rotated by any suitable driven rotor system, but the use of air pressure is particularly convenient. Thus the bell-shaped members can form part of, in each case, an air turbine. Also, air

bearings utilising air under pressure can, if desired, be used to support rotation of the rotary parts of the device. However these bearings should be supplied with air separately from the air turbines to avoid undesired interactions.

The device operates most effectively when there is a high voltage electrostatic charge between the particles and their target. This can, if desired, be achieved by earthing the target and applying a high voltage to the emerging particles or to the material prior to its becoming particulate.

In a convenient form of the invention the voltages required can be generated internally within the device. If a rotary member carries conductors or magnets and a static part of the device carries the converse, an electric generator arises and the resultant generated voltage can be arranged to charge the particles.

The device is of particular advantage when used in a painting (coating) tool with two turbines incorporating the bell-shaped members and driven by compressed air, which enclose a central tube carrying the deposition material which is then forced outwardly towards the

turbines. Both bell-shaped members produce a form of centrifugal acceleration of the paint particles which are at least partially atomised as they strike against the inner surfaces of the bell-shaped members. The atomised particles are then propelled in the general direction of the object to be painted (coated). The resulting coating has a characteristically very smooth and even surface profile.

Both turbines are supported preferably on air bearings. The compressed air can be fed to each turbine through an inlet or inlets in the casing and which then exits to atmosphere, and can be supplied separately and in parallel, in each case to a hollow cylinder bearing downstream from the turbine drive in a parallel operation which also exits to atmosphere.

It was found that counter rotation of the two turbines reduces the required speed considerably while improving the quality of the coating. Conventional turbine driven paint tools rotate at a speed ranging from 16,000 min^1 and 70,000 min^1 while counter-rotation enables the speed of each turbine to be reduced to approximately 10,000 min^1, or in some cases as low as 5,000 min^1. As a result, the size and weight of the turbines can be

reduced. The propelled compressed air is able to have a lower kinetic energy content which ultimately means that the volume of the compressed air generating blower or ventilator can be reduced. All these factors play a decisive role if the output of the paint (coating) application tool has to be directed very precisely over the object to be coated, as is the case for instance, for vehicle bodywork paint spraying systems.

A desirable aim in many cases is to reduce weight and to this end it is preferable that when perforated hollow cylinders are used to provide air bearings, the cylinders are of plastics or ceramic materials. For a quick and economical change of coating medium, e.g. the colour of a car paint, the components carrying the coating medium may be in the form of a ceramic, metal or composite outer casing having suitably selected surface properties.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawing.

The figure shows a longitudinal section through a coating tool. The surface to be painted is labelled 1, and is located at a distance from the tool which is dependent

on the application parameters to be used. The tool essentially comprises a central tube 2, which carries a coating medium which has been supplied from an external supply source, an inner turbine 3 an outer turbine 4, together with supporting bearings (in this case air bearings) 10 and 11 and a fixed casing 5.

Both turbines are driven by compressed air which passes from the rear of the casing to the turbine blades 8 and 9, through separate supply holes. Similar supply connections are provided for reverse or braking motion of the turbines 8A and 9A. The impact surfaces of the turbine blades 8 and 9 are so arranged that the turbines 3 and 4 rotate in a counter direction to one another.

In the case described, the bearings provide both axial and radial support for the turbines by the use of air, supplied from a connection on the housing through numerous controlled passageways 15 and 13 to accurately controlled voids between the static and rotating surfaces. The air then exhausts through passage 6. The turbines 3 and 4, thus supported are centred and free to rotate on air bearings while having no physical contact with each other or their bearings, or the casing 5.

Carried at the ends of the turbines 3 and 4 are bell shaped members 23 and 24. These are arranged so as to rotate concentrically, with the end of the inner bell shaped member 23 being inside the outer bell shaped member 24, and the outer bell-shaped member extending beyond the front edge of the inner bell-shaped member. In the case described, the outer bell shaped member has an inner surface, at its end which is of a selected shape and roughness 24A to promote atomisation, while the inner bell shaped member incorporates a conical diffuser 21 and a transfer disc 23A, which are integral with the inner bell-shaped member and therefore rotate integrally with it. The roughened surface of the outer bell-shaped member should extend from a region opposite the tip of the inner bell-shaped member to the outermost end, or tip, of the outer bell-shaped member.

At the end of the medium supply tube 2 is a controlled orifice which ejects the coating medium onto the diffuser 21 which is revolving as part of the inner bell shaped member 23, 23A. This diverts a proportion of the medium through a controlled gap between the inner bell shaped member 23 and the transfer disc 23A while allowing the remainder to pass through a hole or holes in the transfer disc, to the front of the rotary transfer disc 23A.

By virtue of the centrifugal forces exerted on the coating medium by the rotational movement, the medium passes, either side of the transfer disc, to be thrown from the tip in a generally radial trajectory 26. The spray thus produced, now impinges on the roughened inner surface of the outer bell shaped member 24A which has the effect of "atomising" and shaping the trajectory of the droplets.

The cone of mist may then be subjected to the effects of shaping from the air curtain produced by the controlled passage of air through a shaping air ring 27, via supply line 27A.

The application of a high electrostatic potential between the coating medium and the target 1 will enhance the performance. This electrostatic charge can be applied outside the tool (via electrodes penetrating the mist) or inside via a connection to the paint tube from an externally or internally generated source, and can be applied to the medium prior to, during or after atomisation.

Various other features may be included in the tool, such as speed indication (and control via external equipment).

This is achieved by the feedback of optical, electrical, pneumatic or audible signals to a suitable output device from the turbines.

Hole 19 on the drawing is an access for a pin to lock the turbine to facilitate removal and replacement of the bell.

The application of a high voltage between the tool and the surface 1 which produces an electrostatic acceleration of the atomised paint particles, is not shown. This can as previously mentioned be supplied from an external source or it can be generated by the counter-rotation movements of the outer and inner turbines 4 and 5 to allow this high voltage to be generated using a generator effect arising from the relative movement of these components.

The invention is not limited to the exemplary design described above. A number of variants is conceivable which are able to make use of features of the invention, even where some aspects of detail may be different.

CLAIMS:

1. A device for transmitting a beam of material in particulate form

comprising an outer bell-shaped member which is rotatable about a principal axis and arranged to project a conical curtain of small particles flowing generally towards a target,

supply means for supply of material from a reservoir source and centrally outwards from said principal axis and towards a peripheral internal shaping region of said outer bell-shaped member to create said conical curtain of small particles

characterised in that an inner rotary bell-shaped member is provided coaxially with said outer bell-shaped member and is arranged to rotate at a different rate to that of said outer bell-shaped member so that at least a major part of the material emerging from said supply means is subject to differing rotary forces imparted by both the inner and outer rotary bell-shaped members.

2. A device for transmitting a beam of material according to Claim 1 in which each bell-shaped member is

integral with an air turbine which is driven by air pressure to rotate said bell-shaped member.

3. A device for transmitting a beam of material according to Claim 1 or 2 in which each bell-shaped member is arranged to be supported and rotated on air bearings.

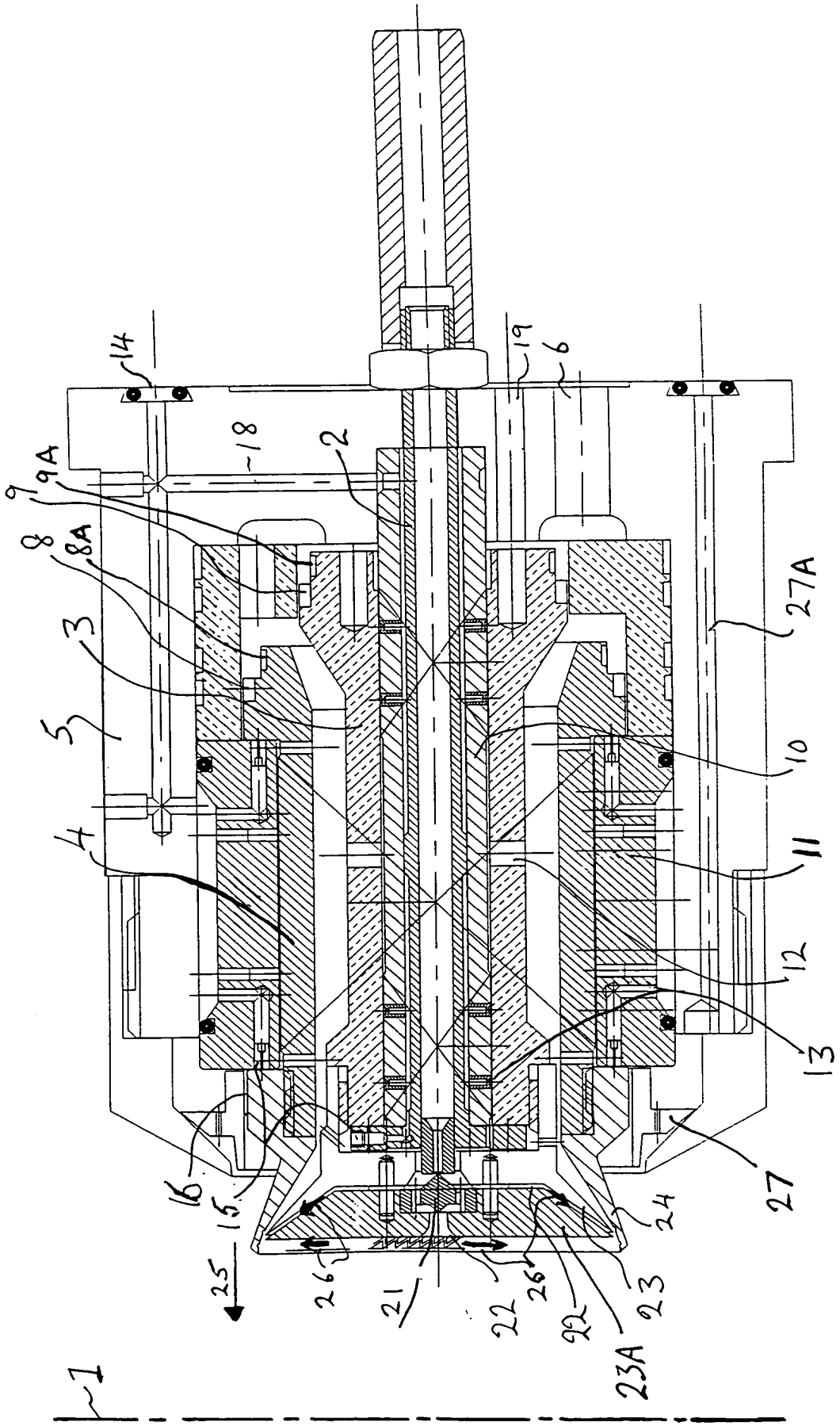
4. A device for transmitting a beam of material according to any preceding claim comprising a centrally located rotary diffuser disc for transmission of material from said supply means and to the inner rotary bell-shaped member.

5. A device according to Claim 4 which includes a centrally located rotary deflector which is arranged to deflect at least some of the emergent material into contact with an internal surface of said inner bell-shaped member.

6. A device according to Claim 5 in which said diffuser disc and said deflector are integral with said inner bell-shaped member so as to rotate therewith.

7. A device according to Claim 6 in which said disc has

apertures therethrough so that some of said material can pass through said apertures and onto an external face of said disc so as to be forced outwards centrifugally towards the outer bell-shaped member.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